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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|-------------------------|
| 10/660,151 | 09/11/2003 | Songlin Xu | 004994 | 4946 |
| 44182 | 7590 | 02/08/2005 | ALRT/ETCH/SILICON | |
| | | | EXAMINER | |
| | | | LUK, OLIVIA T | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2812 | |
| | | | | DATE MAILED: 02/08/2005 |

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|------------------------|---------------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 10/660,151 | XU ET AL. | |
| | Examiner | Art Unit | |
| | Olivia T. Luk | 2812 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on _____.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 19 and 20 is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-18 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input checked="" type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____. |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____. | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| | 6) <input type="checkbox"/> Other: _____. |

DETAILED ACTION

Election/Restrictions

- I. Claims 1-18, drawn to process, classified in class 438, subclass 585.
- II. Claims 19 and 20, drawn to apparatus, classified in class 257, subclass 1.

The inventions are distinct, each from the other because of the following reasons:

1. Inventions I and II are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case the process need not be carried out using a computer readable medium with program as claimed.
2. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.
3. During a telephone conversation with Robert Mulcahy on 2/2/05 a provisional election was made with traverse to prosecute the invention of process, claims 1-18. Affirmation of this election must be made by applicant in replying to this Office action. Claims 19 and 20 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

4. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Information Disclosure Statement

4. The information disclosure statement (IDS) submitted on 9/1//03 has been considered by the examiner.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nallan et al. (6,322,714 B1).

In re claim 1, Nallan et al. disclose flowing a first gas mixture into a plasma reactor **40** containing a substrate **45** with a polysilicon layer **170** formed thereon, the polysilicon layer being masked by a hard mask **195**, the first gas mixture comprising a bromine-containing gas (col. 8, lines 16-18), a chlorine-containing gas (col. 8, line 24), an oxygen-containing gas (col. 7, line 1), and a NF₃ (col. 10, line 24); and maintaining a plasma of the first gas mixture to etch the

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polysilicon layer; and wherein flowing the first gas mixture comprises flowing the bromine-containing gas into the plasma reactor at a first volumetric flow rate, flowing the chlorine-containing gas at a second volumetric flow rate, and flowing the NF₃ gas into the plasma reactor at a third volumetric flow rate, but fails to teach the ratio of the third volumetric flow rate to the sum of the first volumetric flow rate and the second volumetric flow rate being in the range of 1:20 to 1:5.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have the ratio of the third volumetric flow rate to the sum of the first volumetric flow rate and the second volumetric flow rate being in the range of 1:20 to 1:5, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

In re claim 2, Nallan et al. is applied as above, but fails to specify the gas mixture further comprises N₂ gas. However, it would have been obvious to one having ordinary skill in the art to have flowed N₂ gas in the invention since Nallan et al. teaches NF₃ gas and nitrogen gas is known for its inert implanting qualities in etching.

In re claim 3, Nallan et al. is applied as above, but fails to teach flowing the N₂ gas into the plasma reactor at a fourth volumetric flow rate, the ratio of the fourth volumetric flow rate to the third volumetric flow rate being in the range of 0 to 5:1.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to teach flowing the N₂ gas into the plasma reactor at a fourth volumetric flow rate, the ratio of the fourth volumetric flow rate to the third volumetric flow rate being in

the range of 0 to 5:1, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

In re claim 4, Nallan et al. disclose flowing a second gas mixture into the plasma reactor, the second gas mixture comprising a bromine-containing gas, a chlorine-containing gas, an oxygen-containing gas, and NF₃, and maintaining a plasma of the second gas mixture to etch the polysilicon layer (col. 8, lines 15-45); but fails to teach wherein flowing the second gas mixture comprises flowing the bromine-containing gas at a fifth volumetric flow rate, flowing the chlorine-containing gas at a sixth volumetric flow rate, and flowing NF₃ at a seventh volumetric flow rate, the ratio of the seventh volumetric flow rate to the sum of the fifth volumetric flow rate and the sixth volumetric flow rate being less than the ratio of the third volumetric flow rate to the sum of the first volumetric flow rate and the second volumetric flow rate.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to flowing the second gas mixture comprises flowing the bromine-containing gas at a fifth volumetric flow rate, flowing the chlorine-containing gas at a sixth volumetric flow rate, and flowing NF₃ at a seventh volumetric flow rate, the ratio of the seventh volumetric flow rate to the sum of the fifth volumetric flow rate and the sixth volumetric flow rate being less than the ratio of the third volumetric flow rate to the sum of the first volumetric flow rate and the second volumetric flow rate, since Nallan et al. teach the ratio of the inorganic fluorinated gas to the other gas constituents controls many of the unexpected features of the present process (col. 9, lines 32-53) and it has been held that where the general conditions of a

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claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

In re claim 5, Nallan et al. disclose the polysilicon layer includes dopants of one or more kinds and a dopant concentration for each kind of dopants varies with a depth into the polysilicon layer (col. 7, lines 22-27).

In re claim 6, Nallan et al. disclose the polysilicon layer comprises an upper part and a lower part, the dopant concentration for each kind of dopants being higher in the upper part than in the lower part, and wherein the second gas mixture is flowed into the plasma reactor after portions of the lower part of the polysilicon layer are exposed to the plasma of the first gas mixture (col. 7, lines 32-36).

In re claim 7, Nallan et al. fails to disclose the second gas mixture further comprises N₂.

It would have been obvious to one having ordinary skill in the art to have flowed N₂ gas in the invention since Nallan et al. teaches NF₃ gas and nitrogen gas is known for its inert implanting qualities in etching.

In re claim 8, Nallan et al. is applied as above, but fails to disclose flowing the N₂ gas into the plasma reactor at an eighth volumetric flow rate, the ratio of the eighth volumetric flow rate to the sum of the fifth volumetric flow rate and the sixth volumetric flow rate being smaller than ratio of the fourth volumetric flow rate to the sum of the first volumetric flow rate and the second volumetric flow rate.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to flowing the N₂ gas into the plasma reactor at an eighth volumetric flow rate, the ratio of the eighth volumetric flow rate to the sum of the fifth volumetric flow rate and

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the sixth volumetric flow rate being smaller than ratio of the fourth volumetric flow rate to the sum of the first volumetric flow rate and the second volumetric flow rate, since Nallan et al. teach the ratio of the inorganic fluorinated gas to the other gas constituents controls many of the unexpected features of the present process (col. 9, lines 32-53) and it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

In re claim 9, Nallan et al. fails to disclose the ratio of the eighth volumetric flow rate to the seventh volumetric flow rate is substantially the same as the ratio of the fourth volumetric flow rate to the third volumetric flow rate.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have the ratio of the eighth volumetric flow rate to the seventh volumetric flow rate is substantially the same as the ratio of the fourth volumetric flow rate to the third volumetric flow rate in the invention, since Nallan et al. teach the ratio of the inorganic fluorinated gas to the other gas constituents controls many of the unexpected features of the present process (col. 9, lines 32-53) and it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

In re claim 10, Nallan et al. disclose the bromine-containing gas comprises one or more of HBr, Br₂, and CH₃Br (col. 8, lines 27-29).

In re claim 11, Nallan et al. disclose the chlorine-containing gas comprises one or more of Cl₂ and HCl (col. 8, lines 39-42).

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In re claim 12, Nallan et al. disclose the oxygen-containing gas comprises one or more of O₂ and He-O₂ (col. 8, lines 53-57).

In re claim 13, Nallan et al. disclose applying a first bias power to the plasma chamber to electrically bias the substrate with respect to the plasma of the first process gas, maintaining the plasma of the second process gas comprises applying a second bias power to the plasma chamber to electrically bias the substrate with respect to the plasma of the second process gas, and the first bias power being greater than the second bias power (col. 15, lines 40-45; col. 16, lines 31-36).

In re claim 14, Nallan et al. disclose the polysilicon layer comprises N-doped and P-doped regions that are etched simultaneously (col. 18, lines 35-40).

In re claim 15, Nallan et al. disclose the bromine-containing gas comprises one or more of HBr, Br₂, and CH₃Br (col. 8, lines 27-29).

In re claim 16, Nallan et al. disclose the chlorine-containing gas comprises one or more of Cl₂ and HCl (col. 8, lines 39-42).

In re claim 17, Nallan et al. disclose the oxygen-containing gas comprises one or more of O₂ and He-O₂ (col. 8, lines 53-57).

In re claim 18, Nallan et al. disclose the bromine-containing gas is HBr and the chlorine-containing gas is Cl₂ (col. 8, lines 27-42).

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. References not applied are considered state of the art in the area of semiconductor manufacture.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Olivia T. Luk whose telephone number is 571-272-1676. The examiner can normally be reached on 8AM to 5PM Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael S. Lebentritt can be reached on 571-272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

OTL
February 3, 2005



MICHAEL S. LEBENTRITT
PRIMARY EXAMINER